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LAIT – The Laboratory for Audience Interactive Technologies: Don't "Turn it Off" — "Turn it On!"

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Abstract

The **Laboratory for Audience Interactive Technologies (LAIT)**, has been established at the University of Illinois Urbana-Champaign to investigate possibilities for mobile devices to enhance the dramatic and informational experience of audiences at theatrical events, including dance, theater, music concerts, sports events, and installation. LAIT has a two-fold mission to 1) create a new type of theatrical experience for the 21st century, 2) provide an experimental platform for industries to develop applications for entertainment and informational use. This paper describes a mobile development platform that will enable theatrical producers to rapidly prototype and produce deployable applications that run on services provided either by LAIT or by the end user, without the need to write a custom application for each production. This will provide a cost-effective application solution for individual theater, dance, music, and installation producers. LAIT also intends to provide guidance for aesthetic use of applications within the context of live performance, so that it can enhance or augment that experience, rather than distract or detract from it.

Keywords

Mobile applications, theater, dance, music, installation, augmented reality, LAIT, smartphone, tablet computer, DSL, Unity

Introduction

Growing out of a successful experiment with designing and deploying a custom mobile application for an audience to use during a dance production at the University of Illinois Urbana-Champaign (UIUC), the Laboratory for Audience Interactive Technologies (LAIT) was established at UIUC to investigate possibilities for using mobile devices to enhance the dramatic and informational experience of audiences at theatrical events, including dance, theater, music concerts, sports events, and installation art. LAIT's mission is two-fold: 1) create a new type of theatrical experience for the 21st century, 2) provide an experimental platform for industries to develop cutting edge content for entertainment and informational use. Rather than providing application development services, LAIT is developing a *platform* that will enable theatrical producers to rapidly develop and deploy solutions that run on services provided either by LAIT or the end user. This obviates the need to create a custom application for each production, and provides a cost-effective, rapid development solution for theater, dance, music, and installation producers. LAIT also intends to provide guidance for aesthetic use of mobile technology within the context of live performance, helping users to produce content that can enhance or augment that experience, rather than distract or detract from it.

Background

Kama Begata Nihilum, [1] a dance that premiered at UIUC's Krannert Center for the Performing Arts in February 2014, featured a cast of seven dancers moving onstage with networked iPads that displayed synchronized graphics and texts, controlled by custom software written specifically for this performance. A mobile application made available to the audience provided for the display of additional graphical content including augmented reality, that provided meaningful content to users who pointed their smartphones and tablets at a projection on the stage, that was not available otherwise.

The proximity of the iPads to the bodies of the performers, along with the connection the audience felt to the performance through their personal digital devices, resonated in a tangible way throughout the theater. At a Q&A session after the performance, one audience member said that, because of the smartphone application, he had never felt connected to a performance as he had that evening – he claimed that the experience was highly "interactive." Even after being challenged on his use of that word (in this case, the mobile application afforded no user input capability), he insisted that his experience was "really and truly interactive." Others attending the performance not only echoed these sentiments, but also provided several suggestions for expanded uses of this technology.

The enthusiasm felt by this audience might be explained by Camille Baker's findings that mobile devices can help bring "liveness" and "presence" to performance in the 21st century [2], particularly in the connection among participants in a shared event. Owen, Dobbins, and Rebenitsch also describe similar audience involvement and engagement to what we experienced with *Kama Begata Nihilum*. Their "Theater Engine" performances explore the use of mobile devices for live dance, and the technical and design

considerations necessary for these types of productions. [3] Like *Kama Begata Nihilum*, their highly complex work faced challenges coordinating multiple specialists working many hours on each production as well as challenges with respect to infrastructure and deployment.

To address some of these difficulties and to continue to build on audience enthusiasm for mobile devices as part of performance events, an effort was begun to leverage the research and design resources available through the National Center for Supercomputing Applications at the University of Illinois (NCSA) to develop the expressive, informational, and integrative possibilities afforded by personal digital devices in the context of live performance. The result of this effort is the Laboratory for Audience Interactive Technologies, or LAIT. Taking advantage of the phones, tablets, watches, or other devices an audience member may use to connect to the world around them, LAIT intends to extend that connectivity to the domain of live performance to assist artists in engaging their audience and in conceiving new works with mobile devices at their core.

Artists generally don't have access to the resources necessary to develop and deploy a mobile application. Since the idea of using this technology to enhance or augment live performance is new, they also may not have the ability to readily imagine what might be possible.

LAIT's strategy to counter these deficits is two-fold:

- Develop a platform, or toolkit, to assist artists in creating content for mobile devices and provide a ready delivery method immediately useful in live performance and flexible enough to accommodate last minute changes;
- Consult with individual artists and host group brainstorming sessions to assist creators in conceptualizing how content for mobile devices might be used in live performance.

Defining the problem space

One of the challenges facing a builder of a generalized platform aimed at using audience member's mobile devices in the context of live performance lies in the paucity of previous discussion on the topic. While it bears a resemblance to the design disciplines commonly found in the performing arts, like lighting design or scenic design, its role in the context of performance is not as clearly or easily defined as those disciplines.

Much of our work has been driven by discussing the potential of the platform with prospective users and collaborators. On May 1, 2015, we held a "LAIT Day" general discussion about the capabilities and possibilities that our platform can bring to live events. Participants were asked what role the content provided by the LAIT platform should, or can, play in a performance. Their answers generally make reference to three broad, yet distinct, modes in which a LAIT designer ought to be able to create.

The first of these is the *display*, or exhibition, of content in support of the overall aesthetic of a performance. In *Kama Begata Nihilum*, this was the only functionality afforded. However, we discovered that even simple actions such as the ability to remotely change the color of a phone's screen, display an image, or vibrate the device, can have a profound expressive effect.

Another mode that interviewees felt would be important is leveraging the use of *input* afforded by mobile devices. From allowing a user to click on a button to signal recognition of a specific dance gesture [4] to using the aggregate accelerometer data of an entire audience to drive a particle system projected on a screen behind the performers, the potential of using this kind of data in performance is exciting, even though the technical challenges are complex – particularly on a scale of massively attended events.

The final mode appearing in preliminary discussions about this platform's role is *annotative*. A broad array of performances could benefit from the addition of content to help audience members understand complex art forms. Operas often require supertitles, which now could be provided in many different languages. Novice orchestra concertgoers could learn from the identification of an instrument currently playing a solo. Or, an actor's true motivation could be hinted at via audience's devices.

These three broad modes of content creation, then, function as guidelines for developing the LAIT platform.

LAIT Platform Architecture

LAIT is an extension of the application we built for *Kama Begata Nihilum*. It is being built for speed and reliability, because in live performance, precise cueing times and reliability are absolutely necessary. A performance will suffer, or even fail, if a cue comes too late or doesn't show up at all. Therefore, LAIT is being developed using the Unity 3D game engine, a proven commercial platform used by game developers worldwide. Unity 3D offers a robust scripting layer that allows for extensive customization, along with reliable networking functionality.

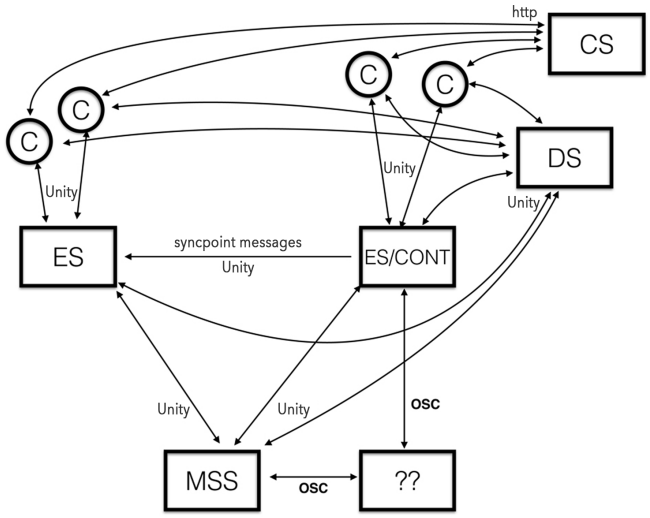

Figure 1. LAIT System Architecture

The LAIT architecture consists of several components whose interconnection is illustrated in Figure 1:

- Client (C) – the mobile device carried by the audience member
- Directory Server (DS) – helps to direct Cs to a server associated with a specific live performance event
- Event Server (ES) – relays cue messages (Qs) to the Cs during a live performance
- Event Controller (ES/CONT) – as above, with additional functionality allowing for the triggering of Qs
- Content Server (CS) – delivers any content needed for the performance
- Message Stream Server (MSS) – accepts and parses input from the audience members' devices
- Other Services (??) – output to other services, computers, and processes

Prior to a performance:

- An audience member downloads the Client (C). Upon launch, C connects to the DS.
- DS sends a list of events that are currently active.
- Audience member chooses the event he/she is attending from the list provided by the DS. This connects C to the event's ES.
- C is directed to download the Q-List and other necessary assets from the CS.
- C parses the Q-List and constructs the content specified within it.

During a performance:

- Q triggers are sent rom the ES/CONT to C's.
- C's response to the Q trigger is described in the specifications of the Q-List (e.g., display a graphic or text, flash a color, vibrate phone, etc.).
- Any input from C (accelerometer data, screen touches, etc.) is passed through ES directly to the MSS.
- MSS collects input from all the ES's. It may choose to process the data itself or pass this data on to an external process. The input data may ultimately be used in or out of the system.

Scalability is achieved by the ability to deploy multiple ESs for any given live performance. If an event were expecting one hundred audience members, one ES would suffice. For five hundred seats, two or three ESs might be necessary, and so forth. Theoretically, LAIT could be scaled to thousands of users. Extensibility is achieved through modular design and by communicating with components outside the LAIT architecture using the Open Sound Control protocol (OSC). [5] OSC is used for data communication among interactive applications, and implementations exist on a wide variety of platforms.

The Domain Specific Language

In order to promote speed, flexibility and ease of use in our networked platform, we have implemented a modular domain specific language (DSL). A "Q-list" Document (QLD) written in the DSL is loaded by the C upon connecting with the Event Server. The QLD tells the C what content or function will be needed during the performance, and associates that content with an integer index, or "Q". Then, during the performance, concise messages containing a Q's index are used to trigger relatively complex sequences on the C, such as displaying a graphic, changing the color of something, playing animations, etc. The capability to execute these Qs is handled by *modules*, components that function similarly to plug-ins, each of which provides a specific capability to the LAIT system. Thus, the architecture has been structured to easily add capabilities as desired, such as dynamic location detection, biometrics, etc.

For example, in order to display a background color on the C, a plane must be created and a color applied to the plane. Specifying the color of the plane requires at least 256 bits of data for four floating-point numbers describing its red, green, blue, and alpha values. This number grows when adding consideration for the position, size, and orientation of the plane on which the color is to be displayed, and greatly increases if animating it on the fly. It is easy to see that sending messages of this size to hundreds of phones at the same time is inefficient, leading to latency and lost information on even robust wireless networks. However, since the C has pre-loaded the QLD, a single integer is all that is required to perform actions on a C.

While loading the event-specific QLD in advance of the performance allows for efficient use of network bandwidth, it also necessitates an abstraction of the content to be delivered to the device. This abstraction is further being used in the development of a simple WYSIWYG tool for content creation that automatically generates the QLD for use in the LAIT infrastructure. This tool will allow non-specialists to create their own content for mobile-device enabled events, significantly lowering the overhead and development time when compared with building a custom application.

Initial Experiments

LAIT exists at the intersection of performance and HCI as posited by Spence, Frohlich, and Andrews, in their Performative Experience Design (PED) framework. [6] An interesting use of the LAIT system in this context occurred during the American College Dance Festival at Iowa State University in March 2015. Dancers holding mobile devices were guided through an improvisation with LAIT. Just prior to the event, several dancers who volunteered to be leaders had their photos taken and uploaded to the CS (Fig. 1). Then the dancers loaded the LAIT application. At a certain point during the dance, the leaders' photos were displayed randomly on random phones. Dancers then gathered around and followed the movements of the dance leader who appeared on their screen. At another point, the display of random colors was used to form and re-form groups within the mass of dancers. Later, random evocative words were displayed on random devices, inspiring a

collage of movement and sound qualities that redistributed the dancers around the space. In these ways, LAIT melded spectator, performer, and group dynamics into a set of new and complex interactions that would have been otherwise unavailable. This experiment served as a proving ground not only for basic infrastructure and functionality of the system, but also demonstrated the ability to change content dynamically.

An example of LAIT's capabilities as an annotative tool occurred at a concert by the band Cody and the Gateway Drugs at the Krannert Center for the Performing Arts in April 2015. The LAIT system successfully delivered lyrics to patron's devices in synchronization with the live performance. Photos of the band members and promotional materials were also displayed. By offering more information about the band and its repertoire, LAIT was able to extend and enhance the audience's enjoyment and appreciation of the performance.

Conclusion

With LAIT we are hoping to help usher in a new era in live performance, where mobile devices are integrated into events instead of being banned from the performance venue. The usual dictate to turn your phone off at a performance is based on the notion that checking social media or playing games makes it impossible to pay attention to what is happening at the performance, and is distracting to your neighbors. However, if within valid aesthetic parameters, the phone is used to enhance lighting effects, display augmented reality content not otherwise visible, communicate hints regarding a character's motives, or to encourage audience participation by eliciting synchronized movement, then the device can be elegantly integrated into an artist's work, and add value for the event's producers.

Anecdotal experience has shown that people are unwilling to shut down their devices when attending a dance, music concert, drama, or movie. So, why not make use of their tremendous capabilities to push the boundaries of art by augmenting live performance? As we announced to the audience who attended *Kama Begata Nihilum*: "Don't turn your cell phones off, turn them on!"

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Authors Biographies

John Toenjes has a BA from Stanford University, and an MA in Music Composition from the University of Missouri-Columbia. He is Associate Professor and Music Director of the UIUC Department of Dance. His numerous interactive dances and movement-based installations include *Inventions Suite* (Cleveland Ingenuity Festival 2008), and *e's of water* (UW-Milwaukee 2007). He wrote the music and designed the wireless sensor networks for Trisha Brown's *Astral Convertible Reimagined* (UIUC 2010), and for *FraMESHift* (Teatro Astra, Turin, Italy 2011-12). He was Technical Director for IJPAN, the Illinois-Japan Performing Arts Network (2010-13), which produced his *Timings: An Internet Dance*, with dancers co-located internationally and connected to live avatars via Kinect. John is now Director of the Laboratory for Audience Interactive Technologies. http://lait.ncsa.illinois.edu

M. Anthony "Tony" Reimer's passion is designing sound effects and writing music for theater, film, video games and interactive experiences; his compositions and sound designs have been heard in venues across the US and internationally. He has a BGS from Ball State University, an MM in Computer Music and New Media from Northern Illinois University and is pursuing a DMA in Music Composition at UIUC. Tony has been audio director/composer for Mutiny Games. He has designed and implemented interactive installations and data sonification projects at UIUC's Krannert Art Museum and Krannert Center for the Performing Arts. Tony teaches sound design in the UIUC Department of Theater, and is a researcher at NCSA, working on projects involving the use of technology in art.